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Econometric Models and Causality Relationships between Manufacturing and non-Manufacturing Production in Morocco, Tunisia and other Northern African Countries, 1950-2000.

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ABSTRACT

This article presents a general view of economic development in the countries of Magreb, with special focus on Tunisia and Morocco, analyzing the impact of manufacturing and imports on economoic growth, by means of cross correlations, Grangers´s causality analysis and dynamic models: for each country and for a panel of 4 Northern African countries. The analysis shows that these countries have low levels of trade among them and that they could improve their economic development with more industrial production and trade, both among themselves and with other areas as the Mediterranean countries of European Union. EU should in our view have a more positive role to foster economic and educational cooperation with those countries in order to increase their industrial production, income per inhabitant and their levels of employment. The alternative to the lack of cooperation policies could be the increase of disparities with EU and emigration pressures from Northern Africa towards most prosperous countries.

JEL classification: C51, L6, O1, O11, O14, O15, O55
Keywords: Cycles, Nothern Africa, Development.

1. Introduction

Here we analyze the effect of manufacturing and foreign trade con economic growth and fluctuations, by means of econometric analysis and find that the evolution of those explanatory variables accounts at a great extent both for the trend and the fluctuations in real GDP. Although some Northern Africa countries are oil producers with benefits for their economies, all the five here analyzed need to foster manufacturing and foreign trade in order to get higher levels of development in buiding and services. The scarcity of water is a technical problem which could be overcome by technical progress, but there are also other socio-economic problems which have make difficult until now the manufacturing take off, being Tunisia the more advanced country, both in educational level of population and economic development. In section 3 we analyse the correlation between manufacturing and non-manufacturing through 5 approachs, including Granger causality and dynamic econometric models of correction error.

In section 2 we present some data which show that economic growth in some countries of Magreb has been higher than world average and even superior to European Union, EU, countries,

but the high rates of population growth is the main cause of the low values of the rates of growth of real Gross Domestic Product per inhabitant, which have been below to those of Spain Portugal and other EU countries. In that section we also analyse the correlation of the evolution of real GDP in Northern Africa with European Union, and can notice, as usual, that countries with low levels of development of Services show higher fluctuations than the more advances economies.

This article is related with previous studies presented in Guisan and Exposito(2001), Guisan and Exposito(2002), and Guisan and Aroua(2004), and readers can find other complementary information and international comparisons in that sources. Besides in Guisan, Aguayo and Exposito(2001) we analyse the effects of education on the diminution of highly excessive fertility rates and on the increase of real Gdp per inhabitant.

2. Evolution of real GDP per inhabitant and production by sector

We present the evolution of real Gross Domestic Product per head, in dollars at 1990 prices and PPPs. Figures are based on Maddison(2001) for the period 1950-98 and World Bank and data base IDB for the period 1999-2001. Graph 1 shows the evolution of real GDP per head, GDPH, in Algeria (Al), Mauritania (Mt), Morocco (Mo), and Tunisia (Tn), and table 1 shows a comparison of the rates of growth of real Gross Domestic Product, GDP, Population, Pop, and real GDP per inhabitant, in those countris and several EU mediterranean countries.

Graph 1. Evolution of real GDP per head in four countries of Magreb
(thousand of dollars at 1990 prices and PPPs)

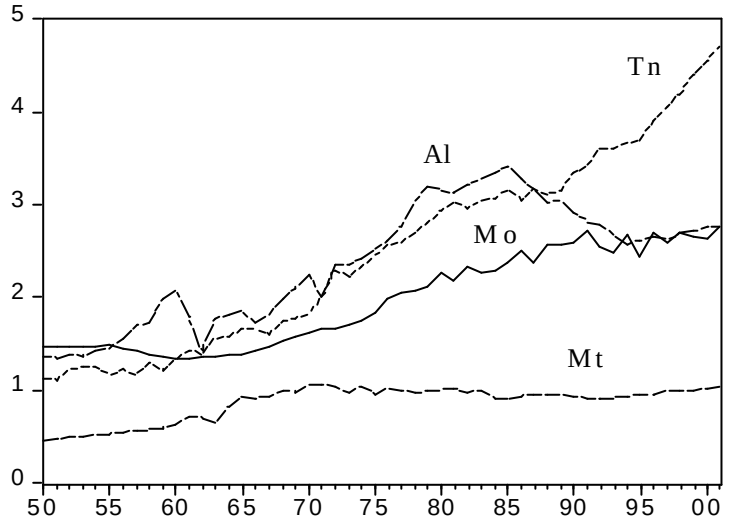


Table 1 present exponential rates of yearly growth of real Gross Domestic Product, Gdp, Population, Pop, and Gdp per inhabitant, Gph, for those countries in comparison with some Mediterranean countries of Europe: France, Italy, Portugal and Spain.

Table 2 shows the evolution of real GDP per inhabitant in the countries of Magreb in comparison with some EU countries.

Table 1. Exponential rates of yearly growth:
Gdp, Population and Gdph in 1960-2000 (percentages)

Country	%Gdp	%Pop	%Gdph
Algeria	3.32	2.63	0.69
Libia[1]	6.55	3.41	3.14
Morocco	3.93	2.21	1.72
Mauritania	3.39	2.18	1.21
Tunisia	5.14	2.10	3.04
Spain	4.38	0.64	3.74
France	3.15	0.61	2.54
Italy	3.20	0.33	2.87
Portugal	4.10	0.37	3.73
World	3.57	1.73	1.83

Source: Own calculation based on figures of real GDP by Maddison(2001) and other statistics.
Note: [1]Figures for Libya are provisional estimations

Table 2. Real GDP per inhabitant
(thousand US dollars at 1990 prices and PPPs)

Pais	1960	1980	2000
Argelia	2.088	3.142	2.757
Libia[1]	1.715	7.600	6.020
Marruecos	1.329	2.272	2.635
Mauritania	0.625	1.006	1.016
Túnez	1.343	2.944	4.540
España	3.437	9.524	15.365
Francia	7.465	15.103	20.649
Italia	5.916	13.153	18.666
Portugal	3.095	8.053	13.768
Mundo	2.781	4.521	5.800

Source: Own calculation based on Maddison(2001) and other statistics.
Note: [1]Figures for Libya are provisional estimations

In Guisan and Exposito(2002) we present the evolution of Nothern African countries for the purpose of comparison. The values of production by sector, and by inhabitant, correspond to real Gdp in Agriculture (pha), Industry (phi), Services (phs), and Total (pht). Agriculture includes also Fishery and Forestry, and Industry includes mining, energy, manufacturing and building activities. Values are measured in US dollars at 1999 prices and purchasing power parities (PPPs). Northern area presents, for each sector, higher values than African averages, and total Gdp by in habitant reached in 1999 a value of 4102 dollars almost double than African average of only 2074, although it represents only a 58% of world average. In this area the highest value of phi corresponds to Algeria, followed by Tunisia, Egypt and Morocco. The highest increases of this variable and of real Gdp per head, in this group of countries during the period 1980-99, corresponds to Egypt and Tunisia.

Table 3 present the low levels of exports of goods and services of those countries

Table 3 . Exports per head. Northern Area (current dollars)

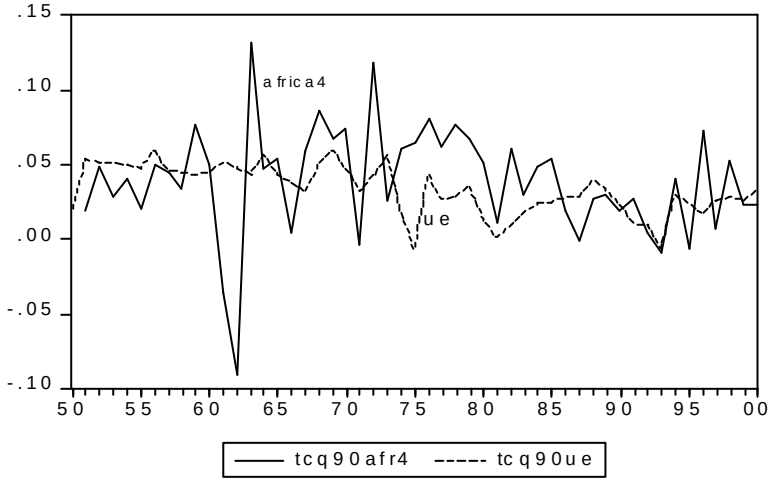
	1990			1998		
Country	Expgh	Expsh	Expth	Expgh	Expsh	Expth
Algeria	453	19	472	343	19	362
Egypt	49	92	141	51	127	178
Mauritania	238	7	245	178	9	187
Morocco	170	75	245	260	92	352
Tunisia	437	195	632	615	285	900
Total Area 1	197	78	275	205	104	309
Africa	143	29	172	128	36	164
World	657	154	810	917	224	1141

Source: Elaboration by Guisan and Exposito(2002) from World Bank Statistics

There is usually a lot of interest in improving foreign trade from Africa to developed countries, but the main trade that many African countries should develop is with their neighbours, as to say trade among countries belonging to the same large area or next areas, which has proved to be fruitful in other parts of the world. With very few exceptions, related with high level of exports of raw materials, the increase of trade depends heavily on industrial development as both variables are closely related, so it is clear that African countries need to improve their industrial production in order to achieve higher standards of development. Several international econometrics models, as those presented in Cancelo, Guisan and Frias(2001) and those presented and cited in Neira and Guisan(2002), show that the educational level of population is also important for increasing industrial production and investment by inhabitant, and thus the main challenge for the future of African countries is to rise the number of average years of schooling of population.

Graph 2 shows the evolution of real GDP in Northern African and EU.

Graph 2. Exponential rates of growth of real GDP (1950-2000)

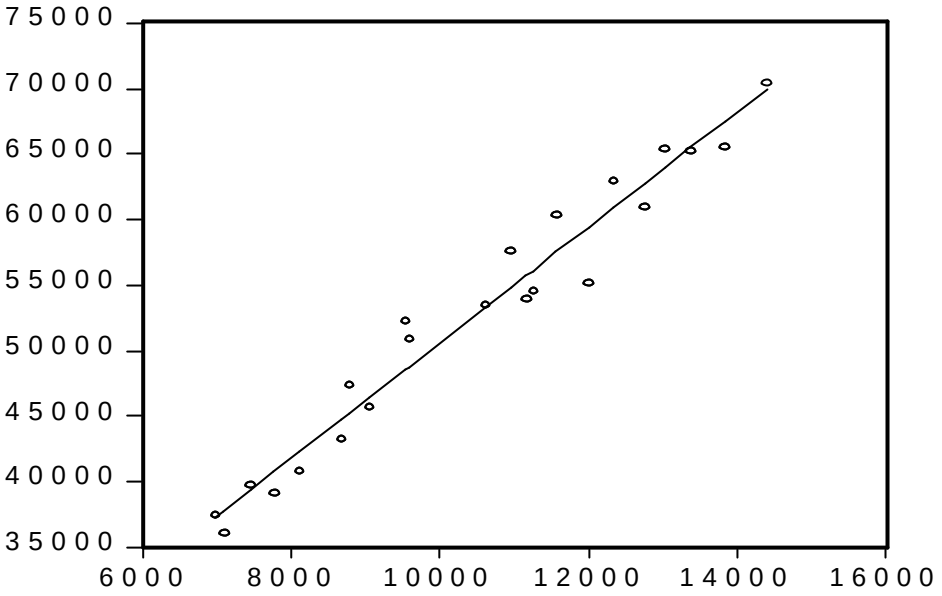


3. The impact of manufacturing and foreign trade on non-manufacturing production

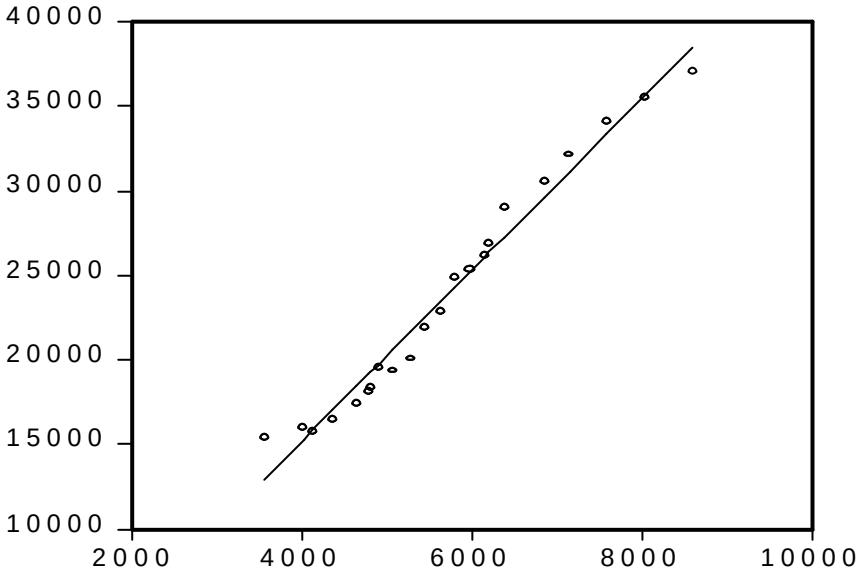
Here we analyse the impact of manufacturing on economic growth through: 1) scatter diagram between real value added in both sectors. 2) Cross correlations. 3) Granger causality analysis 4) estimation of dynamic models for each country. 5) estimation of a dynamic model with a pool of 4 North African countries

Graphs 3 and 4 show the positive relationship between real value added in manufacturing and non-manufacturing activities, for Morocco and Tunisia.

Graph 3. Relation between QNM y QM in Morocco, 1980-2001



Graph 4. Relation between QNM and QM in Tunisia, 1980-2001



Granger causality

Granger causality shows that the positive impact of manufacturing on non manufacturing is accepted in Algeria, Mauritania and Morocco and there is a degree of uncertainty in Tunisia, in spite of the more clear relationship for this country in the scatter and cross correlation.

Pairwise Granger Causality Tests
Sample: 1980 2000
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
QM90TN does not Granger Cause QNM90TN	20	0.95098	0.34314
QNM90TN does not Granger Cause QM90TN		12.4076	0.00261

Pairwise Granger Causality Tests
Sample: 1980 2000
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
QM90TN does not Granger Cause QNM90TN	19	0.94593	0.41179
QNM90TN does not Granger Cause QM90TN		0.96587	0.40462

Pairwise Granger Causality Tests
Sample: 1980 2000
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
QM90MO does not Granger Cause QNM90MO	20	19.5890	0.00037
QNM90MO does not Granger Cause QM90MO		1.34409	0.26234

Pairwise Granger Causality Tests
Sample: 1980 2000
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
QM90TN does not Granger Cause QNM90TN	19	0.94593	0.41179
QNM90TN does not Granger Cause QM90TN		0.96587	0.40462

Pairwise Granger Causality Tests
Sample: 1980 2000
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
QM90AL does not Granger Cause QNM90AL	20	4.42128	0.05070
QNM90AL does not Granger Cause QM90AL		1.28322	0.27303

Pairwise Granger Causality Tests
Sample: 1980 2000
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
QM90AL does not Granger Cause QNM90AL	19	4.21332	0.03694
QNM90AL does not Granger Cause QM90AL		1.08292	0.36535

Pairwise Granger Causality Tests
Sample: 1980 2000
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Probability
QM90MT does not Granger Cause QNM90MT	15	15.8321	0.00183
QNM90MT does not Granger Cause QM90MT		1.46065	0.25010

Pairwise Granger Causality Tests
Sample: 1980 2000
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
QM90MT does not Granger Cause QNM90MT	14	17.3207	0.00082
QNM90MT does not Granger Cause QM90MT		1.36004	0.30472

Although Granger´s causality tests show some contradictory results, due to multicollinearity problems, the hypothesis of some bilateral relationship between Manufacturing and Non-Manufacturing seems to hold in the majority of countries of the world as well as in Magreb countries. Now we present the estimation of some econometric models for Tunisia and Morocco.

Econometric models for Tunisia and Morocco

Tunisia

We present the estimation of a model in levels, a model of Error Correction with contemporanous relationship both long term and short term, and a mixed dynamic model. In this case the EC model was the better and that is the model that we use for the other countries of this study.

1. Model in levels por QNM90TN
Dependent Variable: QNM90TN
Method: Least Squares
Sample(adjusted): 1980 1999
Included observations: 20 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-17451.38	14273.09	-1.222677	0.2392
QM90TN	2.996113	1.358311	2.205764	0.0424
IMP90TN	0.500215	0.199516	2.507141	0.0233
TI	190.9038	236.3572	0.807692	0.4311

R-squared	0.978716	Mean dependent var	22540.07
Adjusted R-squared	0.974726	S.D. dependent var	5816.042
S.E. of regression	924.6311	Akaike info criterion	16.67352
Sum squared resid	13679083	Schwarz criterion	16.87267
Log likelihood	-162.7352	F-statistic	245.2490
Durbin-Watson stat	1.016282	Prob(F-statistic)	0.000000

Model 2.1. Errror Component Model long term
Dependent Variable: QNM90TN
Method: Least Squares
Sample: 1980 2000
Included observations: 21

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5520.032	972.7199	-5.674842	0.0000
QM90TN	3.952329	0.526345	7.509014	0.0000
IMP90TN	0.493938	0.196254	2.516834	0.0215

R-squared	0.981292	Mean dependent var	23157.17
Adjusted R-squared	0.979213	S.D. dependent var	6334.994
S.E. of regression	913.3510	Akaike info criterion	16.60368
Sum squared resid	15015783	Schwarz criterion	16.75290
Log likelihood	-171.3387	F-statistic	472.0796
Durbin-Watson stat	1.121437	Prob(F-statistic)	0.000000

fit YF1

Null Hypothesis: UF1 has a unit root
Exogenous: None
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.794296	0.0007
Test critical values:	1% level	-2.685718	
	5% level	-1.959071	
	10% level	-1.607456	

*MacKinnon (1996) one-sided p-values.

Model 2.2. EC model short term relationship.
Dependent Variable: D(QNM90TN)
Method: Least Squares
Sample(adjusted): 1981 2000
Included observations: 20 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(QM90TN)	4.313132	0.698874	6.171548	0.0000
D(IMP90TN)	0.036865	0.184337	0.199986	0.8439
UF1(-1)	-0.531131	0.180125	-2.948688	0.0090
R-squared	0.345871	Mean dependent var		1004.514
Adjusted R-squared	0.268914	S.D. dependent var		731.3880
S.E. of regression	625.3626	Akaike info criterion		15.85202
Sum squared resid	6648333.	Schwarz criterion		16.00138
Log likelihood	-155.5202	Durbin-Watson stat		1.664676

fit YF2

Model 3. Mixed dynamic model
Dependent Variable: QNM90TN
Method: Least Squares
Sample(adjusted): 1981 2000
Included observations: 20 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
QNM90TN(-1)	1.035319	0.013411	77.20014	0.0000
D(QM90TN)	1.273191	1.283039	0.992324	0.3350
D(IMP90TN)	-0.086116	0.185145	-0.465127	0.6477
R-squared	0.990350	Mean dependent var		23544.58
Adjusted R-squared	0.989215	S.D. dependent var		6239.122
S.E. of regression	647.9328	Akaike info criterion		15.92293
Sum squared resid	7136888.	Schwarz criterion		16.07229
Log likelihood	-156.2293	Durbin-Watson stat		2.489982

fit YF3

We choose model 2.2, which shows the lowe value of the Standard Error of Regression and present significant positive coefficientes for the effects of QM and IMP in the long term equation, and even a positive impact of QM in the short-term equation. This approach of EC models has into account contemporaneous relationships at short term and it is different from the Engle-Granger´s apporach based on non contemporaneous short term relationship. EC Models with contemporaneous short term relationships performs usually very well, similarly to mixed dynamic models, although in this case the mixed dynamic model performs worse and do not show the positive impact of Imports on QNM for the case of Tunisia.

EC Model present also goodness of fit in the case of Morocco, showing the positive impact of manufacturing on non manufacturing, although the model does not show the positive impact of imports on non manufacturing. Imports appear with negative sign and non significant coefficient both in the long term and short term equations, which could be due to problems of multicollinearity or to the low value of this variable in this country.

Model 2.1.for Morocco. EC Model, long term equation
Dependent Variable: QNM90MO
Method: Least Squares
Sample(adjusted): 1981 2001
Included observations: 21 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3119.476	3832.240	0.814008	0.4263
QM90MO	5.144483	0.713746	7.207719	0.0000
IMP90MO	-0.240583	0.223733	-1.075310	0.2964

R-squared	0.959832	Mean dependent var	53343.11
Adjusted R-squared	0.955369	S.D. dependent var	9992.721
S.E. of regression	2111.071	Akaike info criterion	18.27934
Sum squared resid	80219200	Schwarz criterion	18.42856
Log likelihood	-188.9331	F-statistic	215.0587
Durbin-Watson stat	2.762036	Prob(F-statistic)	0.000000

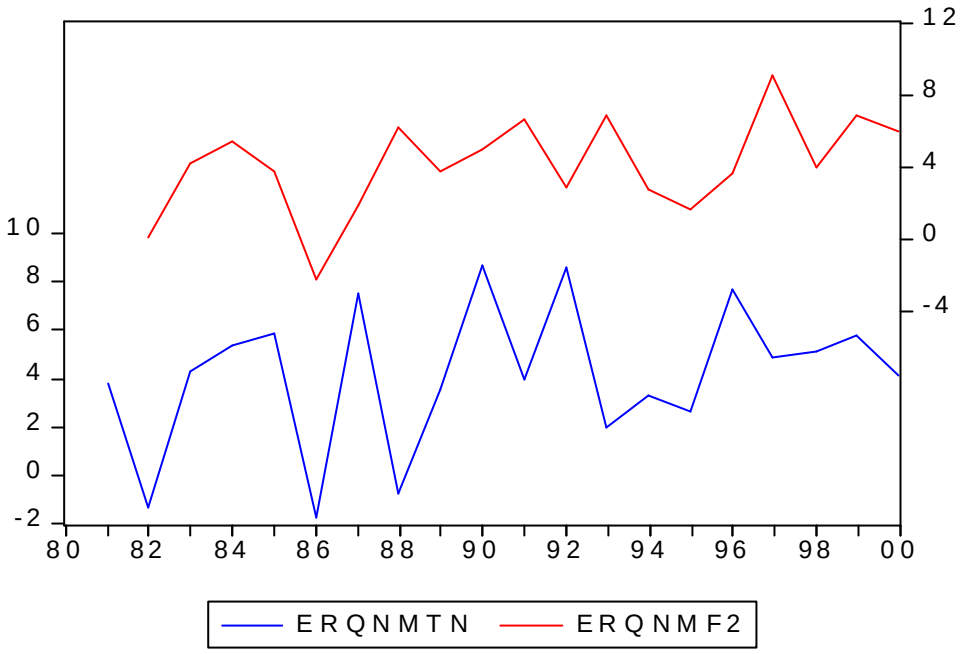
Model 2.2. for Morocco: EC Model, short term equation
Dependent Variable: D(QNM90MO)
Method: Least Squares
Sample(adjusted): 1982 2001
Included observations: 20 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(QNM90MO(-1))	-0.078426	0.194656	-0.402895	0.6924
D(QM90MO)	4.739335	1.254741	3.777143	0.0017
D(IMP90MO)	-0.053135	0.294312	-0.180540	0.8590
UFMO(-1)	-1.314856	0.324181	-4.055927	0.0009

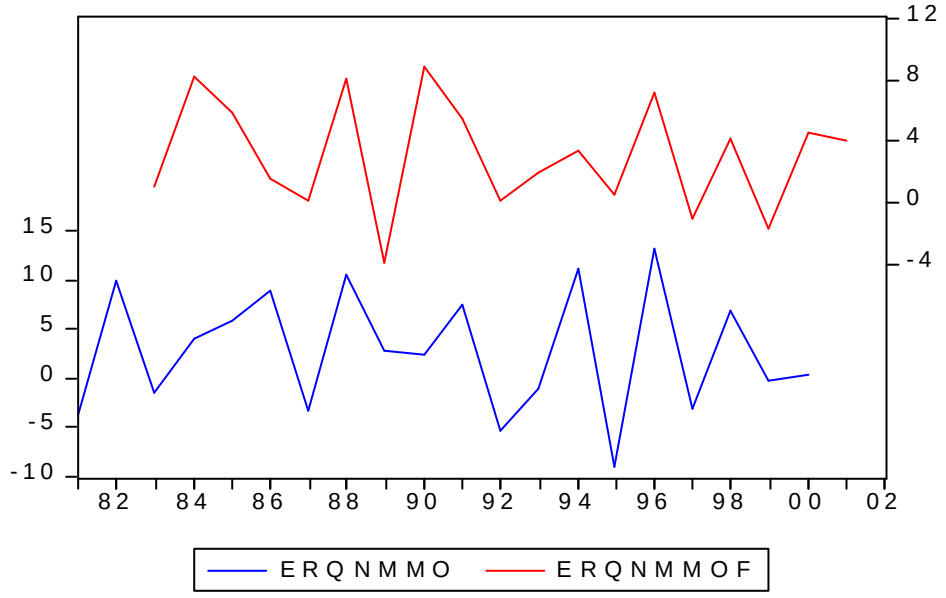
R-squared	0.694215	Mean dependent var	1722.916
Adjusted R-squared	0.636880	S.D. dependent var	3344.656
S.E. of regression	2015.470	Akaike info criterion	18.23195
Sum squared resid	64993937	Schwarz criterion	18.43110
Log likelihood	-178.3195	Durbin-Watson stat	2.028805

Graphs 5 and 6show the similarities between estimated and actual values for the rate of growth of QNM in Tunisia and Morocco, respectively, according to model 2. We present a dual graph, with the actual rates of growth of QNM on the left scale and the forecasted rates of growth of this variable on the right scale, for each country, in order to see separately each rate.

Graph 5. Exponential rates of growth actual and forecasted in Tunisia



Graph 6. Exponential rates of growth actual and forecasted in Morocco



EC Model with contemporaneous short term relationship with manufacturing has a good performance and shows estimated rates of growh very much related with actual ones.

The model did not show good results in Algeria and Mauritania because those countries have had small development of manufacturing. In the case of Algeria the level of QNM per inhabitant is higher than Mauritania because the importance of energy as source of income.

Pool of 4 countries. Estimation of mixed dynamic model

Finally we present the results of the estimation of several dynamic models with a pool of 4 Northern African countries. The 3 equations show the positive impact of manufacturing on the evolution of non manufacturing sectors.

Pool equation 1. LS estimation of mixed dynamic model.

LS: Dependent Variable: QNM90?				
Sample(adjusted): 1981 2001				
Number of cross-sections: 4. Total panel (unbalanced) 79 observations				
White Heteroskedasticity-Consistent Standard Errors & Covariance				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(QM90?)	1.246537	0.743376	1.676859	0.0976
QNM90?(-1)	1.019291	0.006449	158.0580	0.0000
R-squared	0.994045	Mean dependent var		38783.06
Adjusted R-squared	0.993967	S.D. dependent var		25578.41
S.E. of regression	1986.655	Sum squared resid		3.04E+08
Log likelihood	-711.0257	F-statistic		12852.95
Durbin-Watson stat	3.089846	Prob(F-statistic)		0.000000

Pool equation 2. GLS estimation of mixed dynamic model

GLS: Dependent Variable: QNM90?				
Sample(adjusted): 1981 2001				
Number of cross-sections: 4. Total panel (unbalanced) 75 observations				
White Heteroskedasticity-Consistent Standard Errors & Covariance				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(QM90?)	1.612278	0.820651	1.964633	0.0535
QNM90?(-1)	1.018575	0.006598	154.3856	0.0000
TN--AR(1)	-0.024415	0.167946	-0.145374	0.8848
MT--AR(1)	0.141445	0.058122	2.433604	0.0175
MO--AR(1)	-0.737946	0.161023	-4.582862	0.0000
AL--AR(1)	-0.021673	0.260750	-0.083117	0.9340
R-squared	0.996281	Mean dependent var		39415.65
Adjusted R-squared	0.996012	S.D. dependent var		25690.22
S.E. of regression	1622.403	Sum squared resid		1.82E+08
Log likelihood	-657.6684	F-statistic		3697.105
Durbin-Watson stat	2.381840	Prob(F-statistic)		0.000000

Pool equation 3. Model in levels with pool of 4 countries**.**

Dependent Variable: QNM90?				
Method: Pooled Least Squares				
Sample: 1980 2001				
Included observations: 22				
Number of cross-sections used: 4				
Total panel (unbalanced) observations: 83				
White Heteroskedasticity-Consistent Standard Errors & Covariance				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-713.1638	1078.455	-0.661283	0.5103
QM90?	3.343329	0.269796	12.39204	0.0000
IMP90?	1.079819	0.115834	9.322120	0.0000
R-squared	0.821460	Mean dependent var		38209.50
Adjusted R-squared	0.816996	S.D. dependent var		25463.80
S.E. of regression	10893.14	Sum squared resid		9.49E+09
Log likelihood	-887.8029	F-statistic		184.0390
Durbin-Watson stat	0.079223	Prob(F-statistic)		0.000000

5.- Conclusions

The main problems of Northern African countries during the last decades of the 20th century have been: low educational levels, low manufacturing value added per inhabitant, scarcity of water, low levels of foreign trade per inhabitant, high rates of population growth, unemployment, low wages and emigration. There are some differences as the countries with oil production present an important development of production and exports of this product, but all these countries have not enough development of industry, particularly of manufacturing. The agreements between EU and Norther Africa are focused to improve foreign trade, what will have generally a positive effect on their development, but it is not enough to ensure an increase of income and employment needed to avoid massive emigration to EU if the increase in foreign trade is not accompanied by an increase in the educational level of population, industrial investment and development of commercial and social services. The possibilities to expand manufacturing are conditioned at a great extent by the technical solutions to the problem of scarcity of water, which is a very important resource in a process of industrialization.

In the econometric analysis of this study we have shown that the evolution of manufacturing explains at a great extent the evolution of real Value-Added in non manufacturing, not only the trend but also the cyclical fluctuations. We agree with other researchers who think that trend and cycles are generally not separated components of economic growth and development because they have several common explanatory variables, such as manufacturing and foreign trade. These results for Northern Africa agree with other studies cited in the bibliography related with development in the USA, EU, Latin America, East Europe and other areas.

We recommend to improve cooperation from industrialized countries, and particularly from Mediterranean countries of European Union, with African development, mainly related with educational and industrial development. Northern Africa has an important challenge to evolve culturally and socio-economically in order to increase income, employment, and improve the socio-economic wellbeing of their population.

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